POWERPHASEGEVB

POWERPHASEG Evaluation Board User's Manual

ON Semiconductor®

http://onsemi.com

EVAL BOARD USER'S MANUAL

Description

The POWERPHASEG evaluation board is designed such that it can accommodate 2 PowerPhase parts. Depending on the type of application and necessity, any combination of the above packages can also be used. The POWERPHASEG evaluation board is designed to operate with an input voltage ranging from 8 V to 19 V, and to provide an output voltage of 0.8 V to 1.55 V for load currents of up to 25 A. The POWERPHASEG can be ordered with either 5 V or 12 V drivers, but one can be installed at a time. The POWERPHASEG evaluation board has a number of test points that can be used to evaluate its performance in any given application.

Features

- 8 V to 19 V Input Voltage
- 25 A of Steady State Load Current
- 330 kHz Switching Frequency
- Access to IC Features such as Enable, Switching Node and VID Settings for Output Voltage
- Convenient Test Points for Simple, Non-Invasive Measurements of Converter Performance Including Input Ripple, Output Ripple, High Side and Low Side Gate Signals and Switching Node

Applications

- Synchronous Buck Converters
  - High Frequency Applications
  - High Current Applications
  - Low Duty Cycle Applications
- Multi-Phase Synchronous Buck Converters
  - Evaluation Board Has Only One Phase Implemented

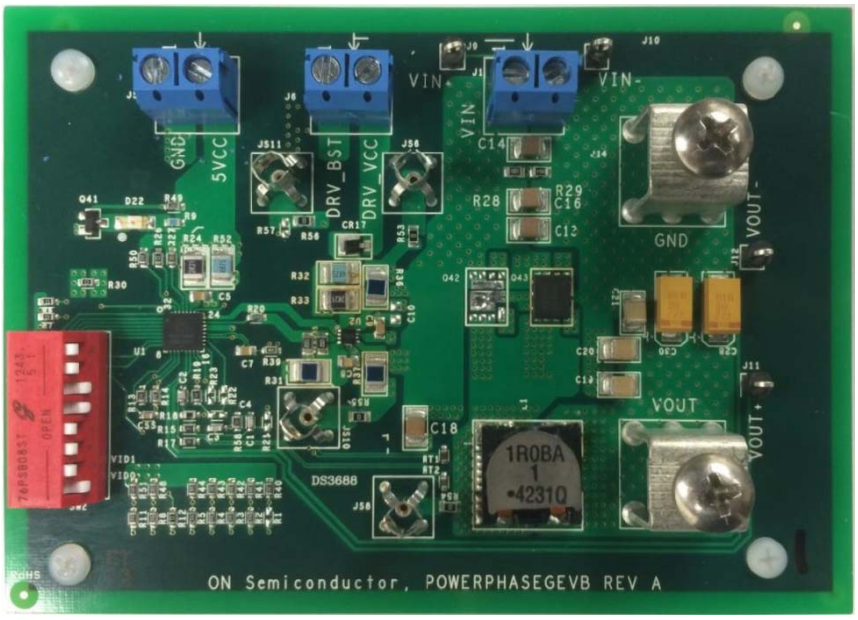

Figure 1. POWERPHASEG Evaluation Board

© Semiconductor Components Industries, LLC, 2014

SCHEMATIC OF THE POWERPHASEG EVALUATION BOARD

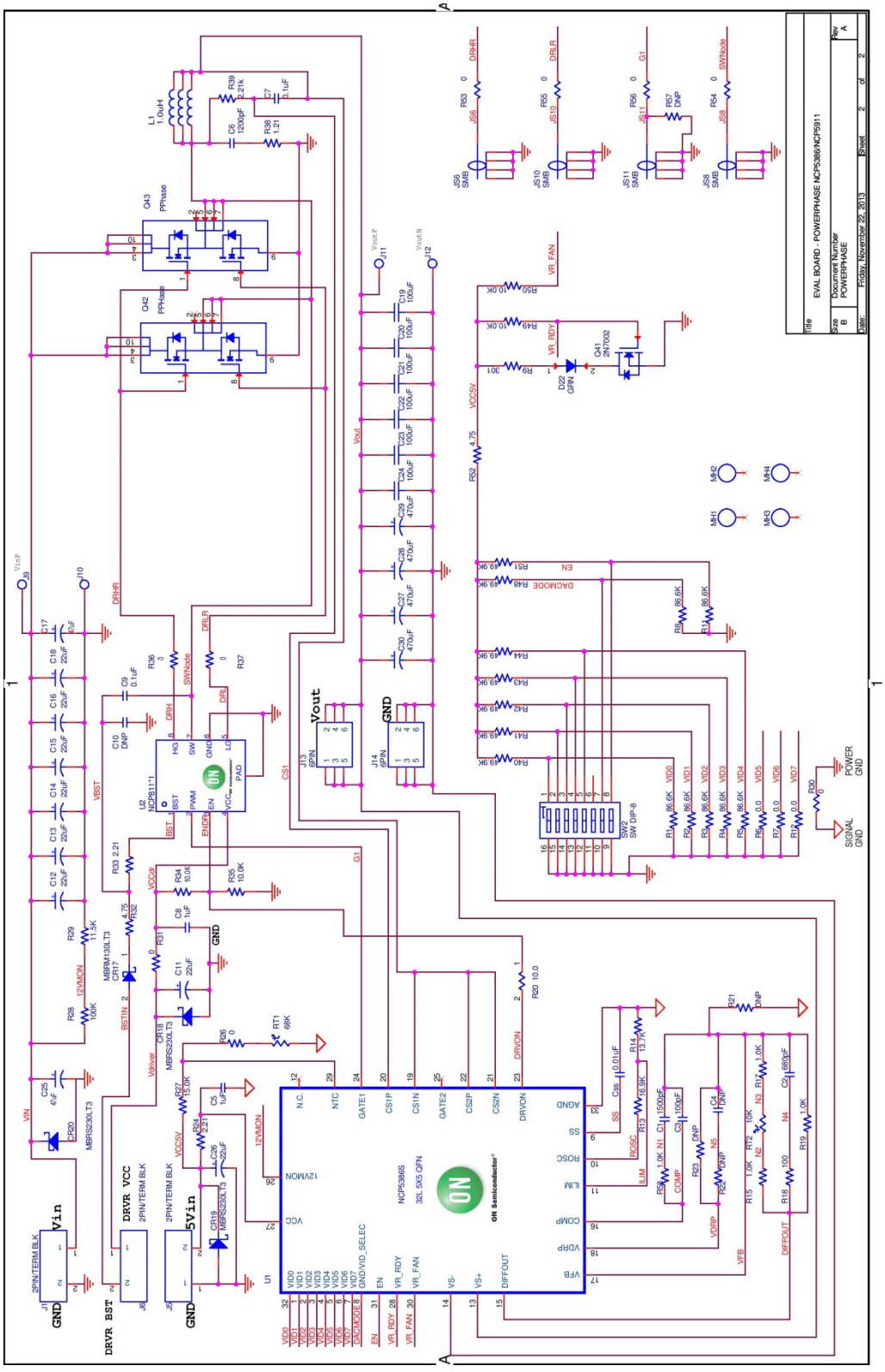

Figure 2. Schematic of the POWERPHASEG Evaluation Board

ELECTRICAL SPECIFICATIONS

Table 1. ELECTRICAL SPECIFICATIONS FOR POWERPHASEG USING NTMFD4C85N

Parameter		Notes and Conditions	Min	Typ	Max	Units
Input Characteristics						
V_{in}	Input Voltage	–	8	12	19	V
V_{drvr}	Driver Voltage	–	5	–	12	V
I_{in}	Input Current	V_{in} = 12 V; I_{out} = 25 A	0	–	3	A
	No Load Input Current	V_{in} = 12 V; I_{out} = 0 A; V_{drvr} = 5 V	0	9	–	mA
		V_{in} = 12 V; I_{out} = 0 A; V_{drvr} = 10 V	0	12	–	mA
Output Characteristics						
V_{out}	*Output Voltage	V_{in} = 12 V; I_{out} = 25 A	0.8	1.2	1.55	V
V_{p-p}	Maximum Switch Node Voltage	V_{in} = 12 V; I_{out} = 20 A; V_{drvr} = 5 V & 10 V	–	18	–	V
I_{out}	Output Current	V_{in} = 8 V to 19 V	0	–	25	A
System Characteristics						
F_{SW}	Switching Frequency	Note 1	–	330	–	kHz
η_{Peak}	Peak Efficiency	V_{in} = 12 V; V_{out} = 1.2 V; V_{drvr} = 5 V	–	91	–	%
η	Full Load efficiency	V_{in} = 12 V; V_{out} = 1.2 V; V_{drvr} = 5 V; I_{out} = 20 A	–	85	–	%

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
*The output voltage can be adjusted by changing the VID settings. See Appendix.
1. The switching frequency is defined by the resistors R13 and R14 and can only be changed only by changing the resistors R13 and R14.

CONNECTORS AND TEST POINTS DESCRIPTIONS

Input Power

Connect the input voltage positive probe to Pin 1 at J1 and sense probe at J9, negative probe to the GND at Pin 2 at J1 and sense probe at J10. The input voltage can range from 8 V to 19 V.

Output Power

Connect the output voltage positive probe to J13 (large screw connector) and sense probe at J11, ground probe at J14 (large screw connector) and the sense probe to J12. The output voltage is set by the VID settings (Refer to Appendix).

Controller Biasing

Connect the positive probe to Pin 2 at J5 and the negative probe to the GND at Pin 1 at J5. Please keep this as a separate supply to avoid damage to the controller especially when other drive voltages are used. Controller $V_{IN\ MAX}$ specification is 7 V.

Driver Biasing

The driver positive voltage probe $_{Vcc}$ should be connected to both pin 1 and 2 at J6. The driver voltage is defined depending on the type of driver installed (i.e.) a 12 V driver or a 5 V driver. The POWERPHASEG evaluation board is set up to accept DFN8 footprints of ON Semiconductor 5 V and 12 V drivers.

Switching Frequency

The converter switching frequency is set by the voltage divider setup of R13 and R14 between the pins 10 (ROSC) and 33 (AGND) of the NCP5386 controller. In order to change the frequency, these resistors have to be changed. Changing the frequency also changes the I_{lim} (Over Current shutdown threshold) settings.

Test Points Description

Monitoring the Input Voltage

The input voltage can be monitored by using the test points at J9 and J10 on the POWERPHASEG evaluation board. This allows the user to find out the exact value of input voltage since there will be no losses from the cables or connectors.

Monitoring the Output Voltage

The POWERPHASEG evaluation board provides two test points for measuring the output voltage without any losses from the cables or connectors. The output voltage can be measured at the points J11 and J12 on the evaluation board.

Monitoring the Switch Node Waveforms

The POWERPHASEG evaluation board provides the opportunity to monitor the switch node waveforms. The probe socket at test point JS8 provides the switch node waveforms.

Monitoring the High Side and Low Side Waveforms

The high side waveforms can be obtained from the probe socket at test point JS6 and the low side waveforms can be obtained from the probe socket at test point JS10.

The probe sockets that are provided on the evaluation board for monitoring the waveforms are such that the oscilloscope probes can be inserted into the probe socket and are held in place. The Test Point and the Probe Socket are shown in Figure 3.

Monitoring the PWM Signal

The PWM signal from the controller to the driver can be monitored from the probe socket provided at JS11.

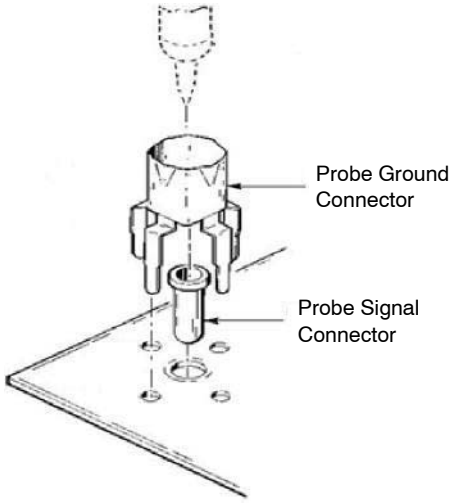

Figure 3. Tektronix Test Point & Probe Socket
Part #: 700503100

TEST EQUIPMENT REQUIRED

Voltage Sources

(i) DC Supply Source for Input Voltage

The input voltage source should be a 0 to 20 V DC source. The input voltage may be increased further depending on the parts that are being used on the POWERPHASEG evaluation board such that the part can withstand the applied voltage. Hence, based on the required input voltage to be applied, the requirement of the DC power supply varies.

(ii) DC Supply Source for Driver Voltage

The supply source for the driver should be a 0 to 20 V DC source. The driver voltage varies depending on the type of driver used (i.e.) For NCP5911 driver, the driver voltage is 5 V and for NCP5901 driver, it is 12 V.

Electronic Load

The electronic load supplied to the POWERPHASEG evaluation board ranges from 0 A to 25 A. Hence a DC current source of 0 A to 30 A is needed for the evaluation board.

Meters to Measure Voltages and Currents

In the POWERPHASEG Evaluation Board, the voltages that are to be measured are V_{in}, V_{out} and V_{drv}. Similarly, the currents that are to be measured are I_{in}, I_{out} and $I_{drvr.}$ The set up for measuring these voltages and currents, and the meters required are shown in Figure 4. The currents are measured across the shunt resistances that are connected across each of the terminals of input, output and driver voltages as shown in Figure 4. For example, the output current is measured as, $I_{out} = V_{out} / R_{sh}$. Similarly the input and driver current can also be measured. The connecting wires from the output terminal to the electronic load should be thicker in order to avoid losses and to measure the exact voltage at the end of the terminals.

Oscilloscope

The oscilloscope is used to monitor the switch node waveforms. This should be an analog or digital oscilloscope set for DC coupled measurement with 50 MHz bandwidth. The resolution can be set at 5 V/division vertically and 20 ns/division horizontally. The oscilloscope channels can be connected at various test points such as High Side Driver (JS6), Low Side Driver (JS10), Switch Node (JS8), G1 PWM Signal (JS11), V_{in} (sense) (J9 & J10) and V_{out} (sense) (J11 & J12).

TEST SET UP AND PROCEDURE

Test Setup

The test set up, test points and components present on the POWERPHASEG Evaluation Board are shown in Figure 4.

The POWERPHASE parts placed on the evaluation board are the Q43 and Q44 (Refer to Figure 1).

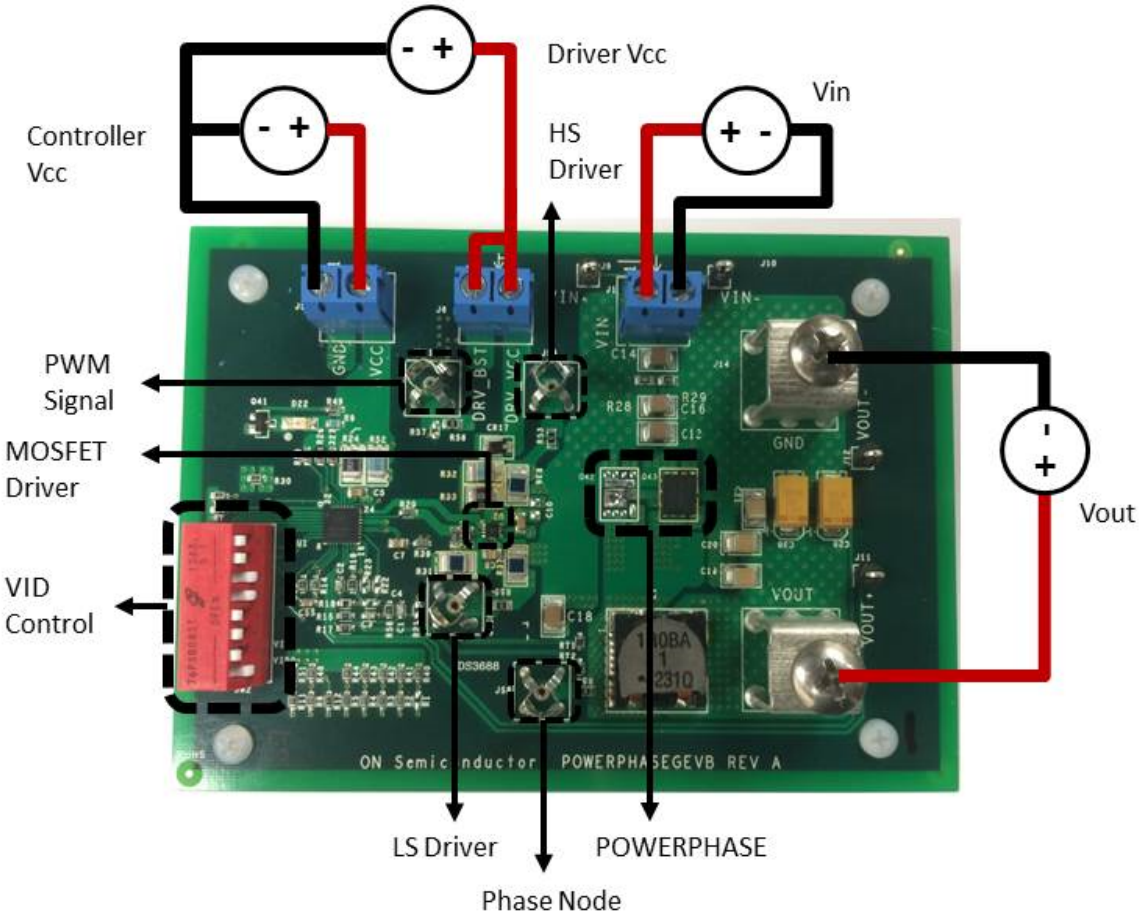

Figure 4. Schematic of the Test Setup

Start Up and Shut Down Procedures

Before starting the test, the oscilloscope probes should be connected. IR or k-type thermo-couples can be used to monitor the temperature of the parts to make sure that they are still within the limits. IR monitoring requires the removal of the oscilloscope probes due to the IR beam interference.

Start Up Procedure:

1. Initially set all the power supplies to 0 V.
2. Set the output voltage by changing the VID settings. The output voltage should not be changed with either the controller or driver active.
3. Set the driver voltage and then set the input voltage.
4. Set the load current to required value. The load current must be incremented slowly to prevent the transient spikes at CS1/CS2 thereby shutting down the controller. If the controller shuts down, the input voltage must be set to zero, then the input power supply has to be turned off, then turned on and V_{in} re-established.

Shut Down Procedure:

1. Shut down the Load.
2. Reduce the input voltage to zero and then shut down the input power supply.
3. Reduce the driver voltage to zero and then shut down the driver power supply.

Test Procedure

1. Before making any connections, make sure to set the power supplies for input voltage and the driver voltage at 0 V. Also make sure that the load current is at 0 A.
2. Connect the Oscillator probes at the desired test points.
3. Set the driver voltage to the required value (For example, V_{drvr} = 5 V).
4. After reaching the required driver voltage, set the input voltage as required. (For example, V_{in} = 12 V).
5. Set the load current slowly to the desired value. For example, I_{out} = 2.5 A. (Refer to *Start Up Procedure #4*).
6. The frequency is already set to 330 kHz. If a different switching frequency is required, R13 and R14 have to be changed as per the data sheet of NCP5386. (Refer to Appendix).
7. Connect the voltmeters/multi-meters to monitor the required parameters. (Refer to Figure 4).
8. Obtain the required data and waveforms.

TEST RESULTS

Efficiency of NTMFD4C85N on POWERPHASEG Evaluation Board for V_{drvr} = 5 V

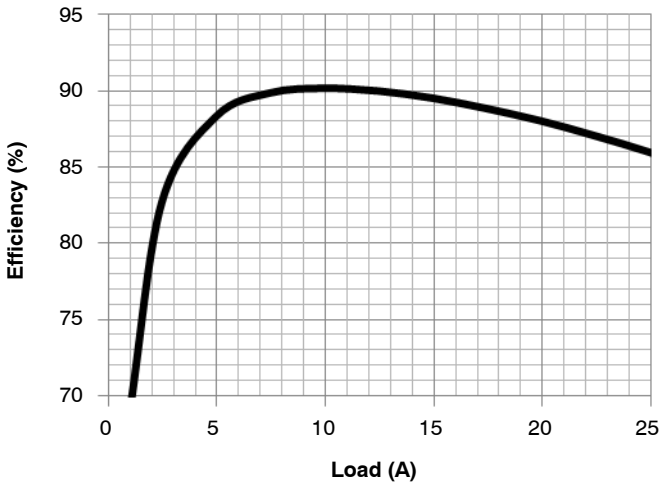

Figure 5. Efficiency for POWERPHASEG Board for V_{drvr} = 5 V

Switch Node Voltage Waveforms of NTMFD4C85N on POWERPHASEG Evaluation Board for V_{drvr} = 5 V

(i) At I_{out} = 20 A and V_{drvr} = 5 V (V_{in} = 12 V; V_{out} = 1.2 V; Freq = 330 kHz)

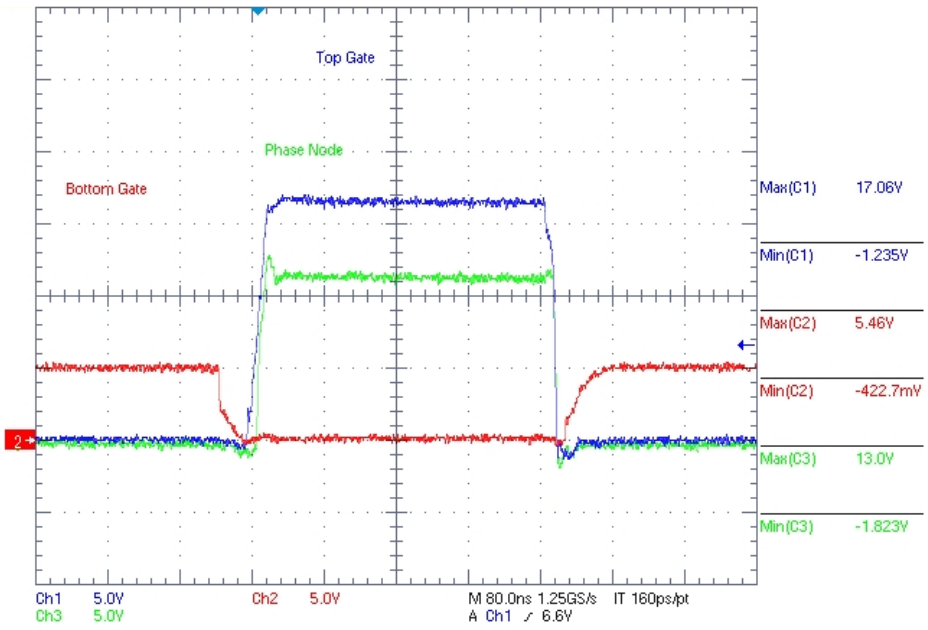

Figure 6. Switch Node Waveforms for V_{drvr} = 5 V

APPENDIX

Table of AMD VID Settings for NCP5386B Controller

The Grayhill 76PSB08ST 8 position switch used for setting the output voltage of the synchronous buck converter. Figure 7 below shows the pin assignment of the switch. VID0–VID5 set the output voltage. DAC, and EN is the enable pin of the controller (controller reset). EN must always be in the up position (1) unless a reset is performed. To set the output voltage to 1.2 V, for example: VID0 = 0 (down), VID1, VID2, VID3 = 1 (up), VID4 = 0 (down), and VID5, DAC, EN = 1 (up).

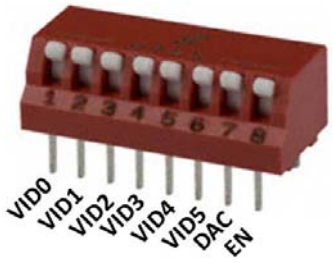

Figure 7. Grayhill Switch Pin Labeling

Table 2. VID CONTROL SETTINGS FOR OUTPUT VOLTAGE

PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8		
VID0	VID1	VID2	VID3	VID4	VID5	DAC	EN	V_{OUT} (V)	Tolerance
0	0	0	0	0	1	1	1	1.5625	±0.5%
1	0	0	0	0	1	1	1	1.5375	±0.5%
0	1	0	0	0	1	1	1	1.5125	±0.5%
1	1	0	0	0	1	1	1	1.4875	±0.5%
0	0	1	0	0	1	1	1	1.4925	±0.5%
1	0	1	0	0	1	1	1	1.4400	±0.5%
0	1	1	0	0	1	1	1	1.4125	±0.5%
1	1	1	0	0	1	1	1	1.3875	±0.5%
0	0	0	1	0	1	1	1	1.3625	±0.5%
1	0	0	1	0	1	1	1	1.3375	±0.5%
0	1	0	1	0	1	1	1	1.3125	±0.5%
1	1	0	1	0	1	1	1	1.2875	±0.5%
0	0	1	1	0	1	1	1	1.265	±0.5%
1	0	1	1	0	1	1	1	1.2400	±0.5%
0	1	1	1	0	1	1	1	1.2125	±0.5%
1	1	1	1	0	1	1	1	1.1900	±0.5%
0	0	0	0	1	1	1	1	1.1625	±0.5%
1	0	0	0	1	1	1	1	1.1375	±0.5%
0	1	0	0	1	1	1	1	1.1125	±0.5%
1	1	0	0	1	1	1	1	1.0900	±0.5%
0	0	1	0	1	1	1	1	1.0650	±0.5%
1	0	1	0	1	1	1	1	1.0400	±0.5%
0	1	1	0	1	1	1	1	1.0125	±0.5%
1	1	1	0	1	1	1	1	0.9875	±0.5%
0	0	0	1	1	1	1	1	0.9625	±0.5%
1	0	0	1	1	1	1	1	0.9375	±0.5%
0	1	0	1	1	1	1	1	0.9125	±0.5%
1	1	0	1	1	1	1	1	0.8900	±0.5%
0	0	1	1	1	1	1	1	0.8650	±0.5%
1	0	1	1	1	1	1	1	0.8400	±0.5%
0	1	1	1	1	1	1	1	0.8125	±0.5%
1	1	1	1	1	1	1	1	Shutdown	

Pin Diagram of NCP5386B Controller

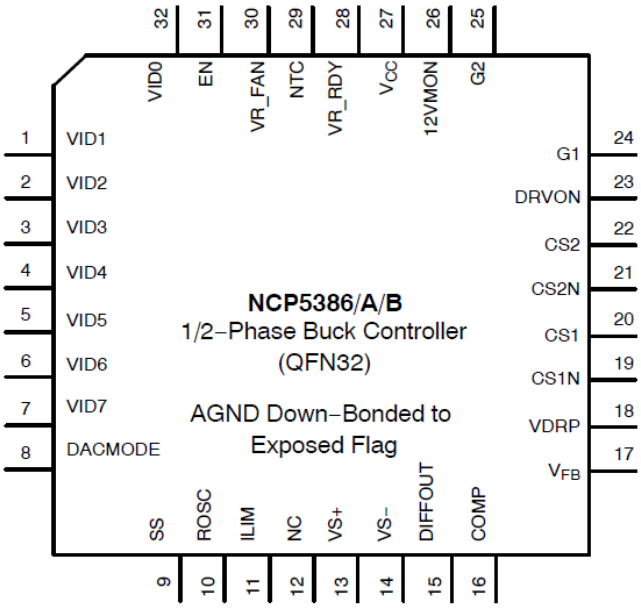

Figure 8. Top View of the Pin Diagram of NCP5386B

Switching Frequency of the Oscillator

The switching frequency of the oscillator can only be changed by changing the resistors R13 and R14.

For more information on NCP5386B: see Data Sheet of NCP5386B.

ON Semiconductor and ON are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

EVBUM2233/D